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Europäisches Patentamt  
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⑪ Publication number:

0 385 243  
A2

⑫

## EUROPEAN PATENT APPLICATION

⑬ Application number: 90103300.1

⑮ Int. Cl. 5. H01J 61/82, H01J 61/073

⑭ Date of filing: 21.02.90

⑯ Priority: 03.03.89 US 318275

⑰ Applicant: GENERAL ELECTRIC COMPANY

⑰ Date of publication of application:  
05.09.90 Bulletin 90/36

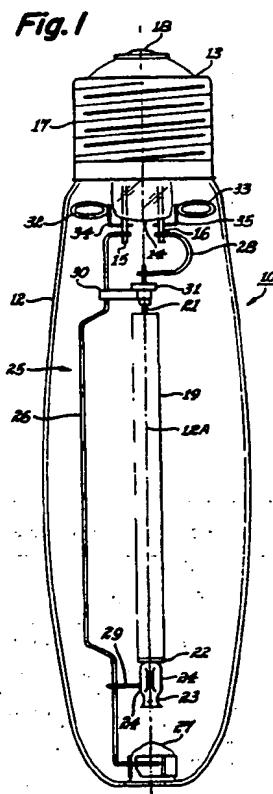
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DE FR GB NL

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⑯ Improved sodium vapor lamp for sonic pulse operation.

⑯ An improved high pressure sodium vapor lamp construction is provided for operation on sonic frequency pulses without excessive acoustic noise. The novel jacketed lamp construction employs non-magnetostrictive metal for the frame employed to suspend a ceramic arc tube within the outer jacket in combination with a particular orientation or placement for ring getter elements located within said outer envelope. Various lamp constructions embodying such improvement are disclosed to enable relatively noise free lamp operation.



**IMPROVED SODIUM VAPOR LAMP FOR SONIC PULSE OPERATION****BACKGROUND OF THE INVENTION**

This invention relates generally to a high pressure sodium vapor lamp construction for operation on sonic frequency pulses and more particularly to an improved structural configuration in said type lamp enabling operation without excessive acoustic noise.

High pressure sodium vapor lamps are now well known and widely used for street, roadway and area lighting applications. The basic lamp type is described in U.S. Patent No. 3,248,590 issued to Schmidt in 1966 and generally comprises an outer vitreous envelope or jacket of glass within which is mounted a slender tubular ceramic arc tube. The ceramic envelope is made of a light transmissive refractory oxide material resistant to sodium at high temperatures, suitably high density polycrystalline alumina or synthetic sapphire. The filling comprises sodium along with a rare gas to facilitate starting, and mercury is generally included for improved operating efficiency. The ends of the alumina tube are sealed by suitable closure members affording connection to the electrodes. The outer envelope is generally provided at one end with a screw base having shell and eyelet terminals to which electrodes of the arc tube are connected. The original high pressure sodium vapor lamps were conventionally operated on 60 cycle alternating current by means of ballasts to limit the current to that of the lamp rating. In such operation, the light generated by the discharge is due almost exclusively to the excitation of the sodium atom through the self-reversal and broadening of the sodium D lines at 590 nanometers. The lamp efficiency is high when operated in such manner, up to 130 lumens per watt depending upon lamp size but the color temperature is low from approximately 1900° to 2100° Kelvin. While colors of the objects being illuminated in all portions of the spectrum are recognizable, those at the "cool" end such as violets, blues and to some extent greens are muted or grayed down. As such, the lamps were not found particularly acceptable for indoor applications where critical color discrimination is required. More recently, however, the color temperature of high pressure sodium vapor lamps has been raised and their color rendition has been improved by employing pulse operation. The principle of such operation is described in U.S. Patent No. 4,137,484 issued to Osteen and assigned to the assignee of the present invention. By utilizing pulse repetition rates in the sonic ranges from about 500 to 2000 Hertz and short duty cycles from about 10 to 30 percent,

the color temperature has been increased from a common value of 2050°K to as high as 2700°K with substantially no reduction in the lamp efficacy, or even higher than 2700°K at the price of some reduction in efficacy.

In still another U.S. Patent No. 4,061,939 issued to Strok and also assigned to the present assignee there is disclosed a jacketed high pressure sodium vapor lamp construction which avoids the undesirable acoustic noise accompanying such sonic frequency pulse operation. More particularly, it is recognized therein that a troublesome audible noise problem is encountered at the pulse operating frequency since the ear is sensitive to an audio range extending from about 16 up to about 20,000 Hertz. Also recognized is that the noise problem is aggravated by the short duty cycle being employed which means an abrupt rise and fall in current at every pulse inducing higher frequency harmonics which may be even more penetrating to the human ear. To effect a noise reduction when such lamps are being operated in this manner, only non-magnetostrictive metals are employed for the major lamp component parts. For example, the ceramic arc tube is said to be constructed with electrode supporting end closures fabricated with non-magnetostrictive metals such as niobium or tantalum. Likewise, a conventional nickel-iron metal frame supporting said ceramic arc tube was found to be another noise source so that non-magnetostrictive titanium metal was substituted in the construction of said lamp parts. A still further reduction of magnetostrictive metals in said lamp construction is also therein disclosed whereby nickel wire inleads are replaced with titanium and copper conductors. Since titanium is further recognized therein to serve as a gettering agent, the customary practice of incorporating ring getter elements in the lamp construction can also be avoided.

Unfortunately a number of the above listed non-magnetostrictive metals for use as components in this type lamp construction are both scarce and expensive commodity items. Thus, titanium is expensive and the effective use of this and other bulk metal getters in the lamp construction frequently requires a careful vacuum heat treatment for outgassing. Ring getter elements employing a vaporizable barium substance, on the other hand, remain a most effective gettering agent for the common impurities found in lamp constructions including water vapor, oxygen, carbon dioxide and nitrogen. Typically, a barium material further containing aluminum and packed within a small circular metal channel ring emits a directional beam of

barium atoms when it is simply subjected to dull red heating by a radio frequency induction coil and with the flashed material thereafter providing effective gettering action. It remains desirable, therefore, to retain use of such ring getter elements in this type lamp construction while still not subjecting the lamp to excessive acoustic noise.

Accordingly, one object of the present invention is to provide means for utilization of ring getter elements in a high pressure sodium vapor lamp being operated by sonic pulses while not causing said lamp to encounter excessive acoustic noise.

Another object of the present invention is to provide a particular combination of at least one ring getter element with other non-magnetostrictive structural components in this type lamp so as to achieve low noise sonic pulse operation.

Still another object of the present invention is to provide means whereby at least one ring getter element is physically positioned in this type lamp so as to avoid acoustic coupling during lamp operation.

These and other objects of the present invention will become more apparent from the more detailed description hereinafter provided.

#### SUMMARY OF THE INVENTION

It has now been discovered that a particular spatial orientation or physical location for a ring getter element when employed in a jacketed high pressure sodium vapor lamp construction can substantially avoid acoustic coupling thereof during sonic lamp operation. More particularly, it has been found that locating said lamp component in the press seal region of the outer lamp envelope or jacket while still further orienting said component in a particular manner with respect to the ceramic arc tube also contained therein provides an unexpected reduction in the mechanical acoustic coupling otherwise occurring between these lamp components. Since the noise results from electromagnetic coupling between the main pulse current loop established in the arc tube during lamp operation and the getter rings it becomes thereby possible to minimize the mechanical acoustic interaction therebetween with relative spatial orientation. Minimizing such coupling effect is achieved by maintaining the plane of the ring getter element substantially perpendicular to the plane of the main lamp current loop as explained hereinafter more fully in connection with the illustrated lamp embodiments. In providing low noise gettering action by such means, it also now becomes possible to eliminate bulk gettering metals in the lamp construction. Thus, titanium can be eliminated as a construction ma-

terial for lamps of this type in favor of such other less expensive non-magnetostrictive metals such as non-magnetic stainless steel and the like. A more cost effective lamp manufacture can thereby be achieved without sacrificing the desired low noise characteristic of lamp operation.

Accordingly, there is generally provided in accordance with the present invention a jacketed high pressure sodium vapor lamp for operation at low noise levels on sonic pulses of short duty cycle comprising in combination: (a) an elongated light transmissive ceramic arc tube having conductive electrode supporting closures sealed to opposite ends and containing an ionizable filling including sodium, said electrodes and closures comprising only non-magnetostrictive metal, (b) an evacuated outer vitreous light transmitting envelope surrounding the arc tube, the outer envelope having a vitreous stem at one end including a press region through which extend a pair of inleads, at least one ring getter element including a vaporizable barium substance being physically supported near the inleads so that a line extending perpendicularly from the plane in which the inleads reside lies substantially perpendicular with respect to a line extending perpendicularly from the plane in which the ring getter element resides, and (c) a metal wire frame within the outer envelope physically supporting and making electrical connection to the arc tube, the frame comprising a long side rod extending from the inner portion of one inlead toward the other end of the outer envelope, and a shorter length of rod extending from the inner portion of the other inlead, both rods being of a non-magnetostrictive metal. The electrodes for such improved lamp construction can be formed with a refractory metal that is non-magnetostrictive such as tungsten or molybdenum and to further include having a coiled configuration which can still further contain an emission material such as dibarium calcium tungstate. The arc tube end closures can be formed with other non-magnetostrictive metals such as niobium or tantalum for sealing directly to the ceramic arc tube with a known vitreous seal glass composition. As hereinabove indicated, the ceramic arc tube can be formed with a polycrystalline alumina ceramic or synthetic sapphire while suitable barium compounds for the ring getter element are also well known.

Representative lamp embodiments hereinafter more fully described are suitable for operation in combination with a generator of electrical pulses across the electrodes, the generator producing rated power input, the pulses having rise rapid enough and a time short enough to produce, in addition to the light resulting from self-reversal and broadening of the sodium D lines, substantial light in the blue-green region of the visible spectrum,

whereby the color temperature is increased and the lamp operation is achieved at low noise levels, and with the lamp constructions generally comprising (a) an elongated light-transmitting polycrystalline alumina arc tube having conductive electrode supporting closures sealed at opposite ends and containing an ionizable filling including sodium and mercury, the electrodes comprising a tungsten metal and closures including at least one ceramic plug element, (b) an evacuated outer light transmitting glass envelope surrounding the arc tube, the outer envelope having a vitreous stem at one end including a press region sealed to a conductive base member, the press region further including a pair of inleads extending vertically inward therefrom, at least one ring getter element including a flashable barium aluminum alloy being physically supported from the inleads so that a line extending perpendicularly from the plane in which the inleads reside lies substantially perpendicular with respect to a line extending perpendicularly from the plane in which the ring getter element resides, and (c) a metal wire frame within the glass envelope physically supporting and making electrical connection to the arc tube, the frame comprising a long side rod extending from the inner portion of one inlead toward the other end of the glass envelope, and a shorter length rod extending from the inner portion of the other inlead, both rods having a non-magnetostrictive metal composition. In one of said illustrated lamp constructions, the ceramic arc tube is closed at one end with a ceramic sealing plug through which extends a niobium wire while the opposite arc tube end is closed with a ceramic sealing plug through which extends a closed niobium tube. Such metal tube and ceramic electrode supporting structure serves as a storage reservoir for excess sodium and mercury being employed to operate the particular lamp. In the remaining lamp being illustrated, both electrode supporting structures closing the arc tube ends are formed with ceramic sealing plugs through which extend niobium wires, which are hermetically sealed at the arc tube ends with a known ceramic sealing frit. The metal wire frame suspending the arc tube in such lamp embodiments can be either totally supported by the lamp inleads or partially supported with a dimpled end provided in the lamp jacket. Still other known configurations for the metal frame suitable in the presently improved lamp construction include laterally extending straps securing the electrode supporting closures to the long side rod as well as a flexible metal strap enabling axial expansion and contraction of the suspended arc tube. For all of said illustrated frame member configurations, however, a non-magnetostrictive iron alloy such as non-magnetic stainless steel is preferred in order to lower the cost of lamp manufac-

ture.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of a high pressure sodium vapor discharge lamp according to the present invention.

FIG. 2 is an exposed sectional view, in a slightly enlarged manner, of the arc tube of FIG. 1 in accordance with one embodiment of the present invention.

FIG. 3 is a high pressure sodium vapor lamp partially broken away so as to show a double wire arc tube as employed in accordance with the present invention.

FIG. 4 is an exposed sectional view of the arc tube of the high pressure sodium vapor lamp of FIG. 3.

FIG. 5 is a sectional view taken through the base portion of the FIG. 3 lamp embodiment.

FIG. 6 illustrates one of the orientations of the present invention of the getter rings relative to the inleads of the lamps of FIGS. 1 and 3.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A high pressure sodium vapor lamp 10 embodying the present invention and corresponding to a conventional 250 watt size is illustrated in FIG. 1. A high pressure sodium vapor lamp generally comprises a vitreous outer envelope 12 which can be glass furnished with a standard mogul screw base 13 attached to the stem end which is shown uppermost in FIG. 1. A reentrant stem press 14 supports a pair of relatively heavy outer inlead conductors 15 and 16 extending through the stem 14 and having outer ends connected to the screw shell 17 and eyelets 18 of the base. The high pressure sodium vapor lamp 10 includes an inner envelope or arc tube 19 centrally located within the outer envelope 12. The arc tube 19 is comprised of a length of light-transmissive ceramic formed of a polycrystalline alumina ceramic which is translucent. The arc tube 19 contains a charge of vaporizable metals having a sodium partial pressure in a range of approximately 50-400 torr and a xenon gas in the range of approximately 10 to 400 torr. The upper end of the arc tube 19 is closed by an alumina ceramic sealing plug 20 through which extends hermetically a niobium inlead 21 which supports an upper electrode (shown more clearly in FIG. 2 to be subsequently described) within the arc tube 19. Similarly, the lower end of the arc tube 19 has a closure which comprises a ceramic sealing

plug 22 through which extends a thin walled niobium tube 23. The ceramic sealing plugs 20 and 22 are described in greater detail in still further U.S. Patent No. 4,065,691 issued to McVey and also assigned to the present assignee. The niobium tube 23 serves both as an inlead for arc tube 19 and as a reservoir for storing excess alkali metal and mercury contained within the arc tube 19. The shank of the lower electrode (shown in FIG. 2 to be described) of arc tube 19 projects into the reservoir tube 23 and is locked in place by crimping the niobium reservoir tube about the lower electrode at location 24 as shown in FIG. 1.

In accordance with the present invention, ceramic arc tube 19 is suspended within the outer glass envelope 12 along centerline 12A by a metal wire frame 25 which is secured to outer inlead conductors 15 and 16. Said frame construction is fabricated with non-magnetic steel wire, such as #316 composition, to include a long side rod 26 extending from inlead 15 to a dimpled protuberance 27 formed in the outer glass envelope and a shorter length curved rod 28 securing niobium inlead 21 to the remaining outer inlead 16. As can be further noted from the drawing, said frame construction further includes laterally extending metal straps 29 and 30 physically securing the arc tube 19 to frame 25 with an electrically insulative bushing 31 also being provided for strap 30 to avoid electrical shorting. A pair of barium ring getter elements 32 and 33 are also physically located within the outer glass envelope 12 according to the present invention. Thus, ring getter elements 32 and 33 are positioned in the press region 14 of said outer envelope with both being preferably suspended by wire elements 34 and 35 from the respective outer inlead conductor 15 and 16. As still further preferred, both ring getter elements are physically displaced to the sides of the flattened press 14 so as to lie in a common horizontal plane oriented substantially perpendicular to a vertical plane intersecting inleads 15 and 16 as well as the arc tube 19 in a manner to be described.

FIG. 2 is a sectional view depicting the arc tube 19 of FIG. 1 in an enlarged manner. Tungsten electrodes 44 and 46 each include a low work function emissive material such as dbarium calcium tungstate which is formed into the coil windings wrapped about the electrode shanks 48 and 50 respectively.

A further lamp embodiment of the present invention is a related double-wire inner arc tube 62 centrally located within a high pressure sodium vapor lamp 60 along its centerline 61 shown in FIG. 3 and supported, in part, by frame member 63. The depicted lamp construction 60 further includes suspension of the arc tube 62 with non-magnetostriictive metal frame wire 63 and inleads 64 and 78

which are physically and electrically connected to inleads 94 and 96 extending vertically from a stem press region 92 of the outer glass envelope 93. A pair of ring getter elements 98 and 100 are further secured to inleads 94 and 96 adjacent the stem press 92 of said outer envelope and in a manner to be more fully described in connection with FIG. 5. A conventional medium base 90 is also provided in the depicted lamp construction.

FIG. 4 shows the arc tube 62, preferably formed of a polycrystalline alumina, as having two oppositely located inleads 64 and 78 formed of niobium wire. The inlead 78 passes through and is supported by sealing plug 80. The inner portion of inlead 78 labeled 82 is connected to a shank 86 by a butt weld 84. The inner portion 82 of inlead 78 is a niobium feedthrough for arc tube 62. The shank 86 is formed of a tungsten metal and has electrode coils 88 having an emission mix between its turns. The emission mix can be dbarium calcium tungstate material. The inlead 64 passes through and is supported by a ceramic sealing plug 66. The inner portion of inlead 64 labeled 68 is connected to a shank 72 by a butt weld 70. The inner portion 68 of inlead 64 is a niobium feedthrough for arc tube 62. The shank 72 is formed of tungsten and has electrode coils 74 similar to the electrode coils 88.

FIG. 5 represents a vertical section 6-6 taken through the base portion of the lamp embodiment depicted in FIG. 3 so that a more detailed explanation can be provided upon required physical positioning of the ring getter elements within the outer envelope 93 according to the present invention. As above described, said base portion includes a standard medium screw base 90 having a reentrant stem press 92 through which extends vertically a pair of relatively heavy inlead conductors 94 and 96 providing sole physical support of the metal wire frame construction (elements 63, 64 and 78) suspending the arc tube member 62 in said FIG. 3 lamp embodiment. Said lamp embodiment further includes as also previously explained a pair of ring getter elements 98 and 100 located in the press region and which are physically secured to the respective inleads 94 and 96. As still further previously explained, however, said ring getter elements are also required to be positioned in the outer lamp envelope 93 so as to minimize any acoustic coupling of these elements when the lamp is being operated. More particularly, said ring getter elements are further required to be physically positioned in the press region with an orientation which minimizes coupling to the pulsed magnetic flux field generated during arc tube operation. To better visualize a proper spatial orientation for the depicted ring getter elements (98 and 100), the present drawing includes a directional vector  $z$  extending perpendicularly or normal from the plane

in which both inlead conductors 94 and 96 supporting the arc tube reside. There is further depicted in said drawing directional vectors B and C both extending perpendicularly or normal to the horizontal plane in which both ring getter elements reside. The orientation of the ring getter elements 98 and 100 relative to the inleads 94 and 96 of FIG. 3 along with the ring getters 32 and 33 relative to inleads 15 and 16 of FIG. 11 may be further described with reference to FIG. 6.

FIG. 6 shows an arrangement 120 of the inleads having an x-axis or directional vector x depicted by line 122 which corresponds to the transverse or horizontal axis of the lamp 60 (FIG. 3) or lamp 10 (FIG. 1), and a y axis or directional vector y depicted by line 124 which corresponds to the centerline or vertical axis of the lamp 60 (FIG. 3) or lamp 10 (FIG. 1). The plane of the inleads is defined by the x and y vectors. The direction vector z discussed with regard to FIG. 5 is also shown in FIG. 6 as line 126 in the z direction extending normally from the plane of the inleads.

FIG. 6 also shows an arrangement 130 of the getter rings having i (line 132), j (line 134) and k (line 136) vectors used to specify a suitable orthogonal coordinate system for the getter rings, where the plane of the getter elements is defined by the i and j vectors. The directional vector k (line 136) is shown in phantom to be extending normal or perpendicular from the plane of the getter elements. The directional relationship between the vectors k and z is indicated by the angle  $\theta$ .

The ring getter elements are desirably positioned in the press region of the outer envelope so that a normal line (126) extending from the plane in which the inleads reside lies substantially perpendicular with respect to a normal line (136) extending from the plane in which the ring getter elements reside. The ring getters positioned to the sides of the press region of the inleads may be oriented in various upward and downward tilted manners because the k vector (line 136 of FIG. 6) of the ring getters remains perpendicular to the z axis of the inleads for all such orientations. A tilted spatial orientation of the depicted ring getter elements (98 and 100) is shown in FIG. 5 to illustrate an alternative acceptable arrangement still adhering to the herein defined orientation requirements for getter elements such as 98 and 100. On the other hand, it has also been found that locating the ring getter elements with respect to the inlead locations can result in failing to meet the defined orientation requirements. For example, a rotational displacement of the ring getter elements 98 and 100 to a position 90 degrees about the lamp centerline (12A of lamp 10 or 61 of lamp 60) in the present drawing would depart from the defined positioning requirements in so far as any tilting of the re-

located elements is adopted. For such positioning, the angle  $\theta$  between the directional vectors 126 and 136 is not perpendicular (90°) which creates undesired acoustic noise discussed in the "Background" section.

In operation, the orientation of the present invention of the getters 98 and 100 relative to the inleads 94 and 96 along with getters 32 and 33 relative to inleads 15 and 16 reduces the magnetic coupling between the getterring and the main pulse current conducted by the inleads which would otherwise create a low level of acoustic noise. The coupling coefficient between the getter rings and main current loop is reduced by the described orientation, more particularly, by orienting the k vector which is normal to the plane i-j of the getters so as to be perpendicular to the z vector which is normal to the plane of the main lamp current loop developed by the current flow within inleads 94 and 96 or inleads 15 and 16.

It will be apparent from the foregoing description that broadly useful means have been provided to improve the operation of high pressure sodium vapor lamps with sonic frequency pulses. As above indicated, however, it is contemplated that numerous modifications can be made in the lamp constructions herein illustrated without departing from the spirit and scope of the present invention. For example, these lamps may employ still other already known basing constructions, arc tube support means, lamp outer envelope shapes and sizes, specialized ballasting circuits and still other lamp variations. Moreover, the present invention contemplates both higher lamp wattage ratings than illustrated such as 1000 watt and lower wattage ratings such as 15 watts. Consequently, it is intended to limit the present invention only by the scope of the appended claims.

## Claims

1. A jacketed high pressure sodium vapor lamp for operation at low noise levels on sonic pulses of short duty cycle comprising in combination:
  - (a) an elongated light transmissive ceramic arc tube having conductive electrode supporting closures sealed to opposite ends and containing an ionizable filling including sodium, said electrodes and closures comprising only non-magnetostrictive metal,
  - (b) an evacuated outer vitreous light transmitting envelope surrounding the arc tube, the outer envelope having a vitreous stem at one end including a press region through which extends a pair of inleads, at least one ring getter element including a vaporizable barium substance being physically supported in the vicinity of the inleads

so that a normal line extending from the plane in which the inleads resides lies substantially perpendicular with respect to a normal line extending from the plane in which the ring getter element resides, and

(c) a metal wire frame within the outer envelope physically supporting and making electrical connection to the arc tube, the frame comprising a long side rod extending from the inner portion of one inlead toward the other end of the outer envelope, and a shorter length of rod extending from the inner portion of the other inlead, both rods being of a non-magnetostrictive metal.

2. The lamp of claim 1 wherein the arc tube closures are niobium.

3. The lamp of claim 1 wherein the vaporizable barium substance is a barium compound.

4. The lamp of claim 1 wherein the arc tube is polycrystalline alumina.

5. The lamp of claim 1 wherein the ring getter elements are supported in a like manner from both inleads.

6. The lamp of claim 1 wherein the non-magnetostrictive metal rods have an iron alloy composition.

7. The lamp of claim 6 wherein the non-magnetostrictive metal rods are stainless steel.

8. The lamp of claim 1 wherein the metal wire frame is entirely suspended by the inleads.

9. The lamp of claim 1 in combination with means for energizing said lamp comprising a generator of electrical pulses across the electrodes, the generator producing rated power input, the pulses having a rise rapid enough and a time duration short enough to produce, in addition to the light resulting from the self-reversal and broadening of the sodium D lines, substantial light in the blue-green region of the visible spectrum whereby the color temperature is increased, and the lamp operation is achieved at low noise levels.

10. A jacketed high pressure sodium vapor lamp unit for operation in combination with a generator of electrical pulses across the electrodes, the generator producing rated power input, the pulses having a rise rapid enough and a time short enough to produce, in addition to the light resulting from the self-reversal and broadening of the sodium D lines, substantial light in the blue-green region of the visible spectrum, whereby the color temperature is increased and the lamp operation is achieved at low noise levels, and the lamp generally comprising:

(a) an elongated light-transmitting polycrystalline alumina arc tube having conductive electrode supporting closures sealed at opposite ends and containing an ionizable filling including sodium and mercury, the electrodes comprising a tungsten metal and the closures including at least

one ceramic plug element,

(b) an evacuated outer light transmitting glass envelope surrounding the arc tube, the outer envelope having a vitreous stem at one end including a press region sealed to a conductive base member, the press region further including a pair of inleads extending vertically inward therefrom, at least one ring getter element including a flashable barium aluminum alloy being physically supported from the inleads so that a normal line extending from the plane in which the inleads resides lies substantially perpendicular with respect to a normal line extending from the plane in which the ring getter element resides, and

(c) a metal wire frame within the glass envelope physically supporting and making electrical connections to the arc tube, the frame comprising a long side rod extending from the inner portion of one inlead toward the other end of the glass envelope, and a shorter length rod extending from the inner portion of the other inlead, both rods having a non-magnetostrictive metal composition.

11. The lamp unit of claim 10 wherein ring getter elements are supported in a like manner from both inleads.

12. The lamp unit of claim 10, wherein the tungsten electrodes have a coil configuration.

13. The lamp unit of claim 12 wherein one electrode further includes an emission material.

14. The lamp unit of claim 10 wherein the arc tube contains a rare gas fill.

15. The lamp unit of claim 10 wherein one electrode supporting closure has a tubular configuration affording a storage reservoir for excessive sodium and mercury.

16. The lamp unit of claim 10 wherein the electrode supporting closures are sealed to the arc tube with a vitreous seal glass composition.

17. The lamp unit of claim 10 wherein the non-magnetostrictive metal rods have an iron alloy composition.

18. The lamp unit of claim 17 wherein the non-magnetostrictive metal rods have a stainless steel composition.

19. The lamp unit of claim 10 wherein the metal wire frame is entirely suspended by the inleads.

20. The lamp unit of claim 10 wherein the glass envelope includes a dimple configuration opposite the base end to help support the metal wire frame.

21. The lamp unit of claim 10 wherein the metal wire frame further includes laterally extending metal straps securing both electrode supporting closures to the long side rod.

22. The lamp unit of claim 21 wherein the metal strap securing one electrode supporting closure to the long side rod is electrically insulated from one of the inleads.

23. The lamp unit of claim 10 wherein the metal wire frame further includes a flexible metal strap enabling axial expansion and contraction of the suspended arc tube.

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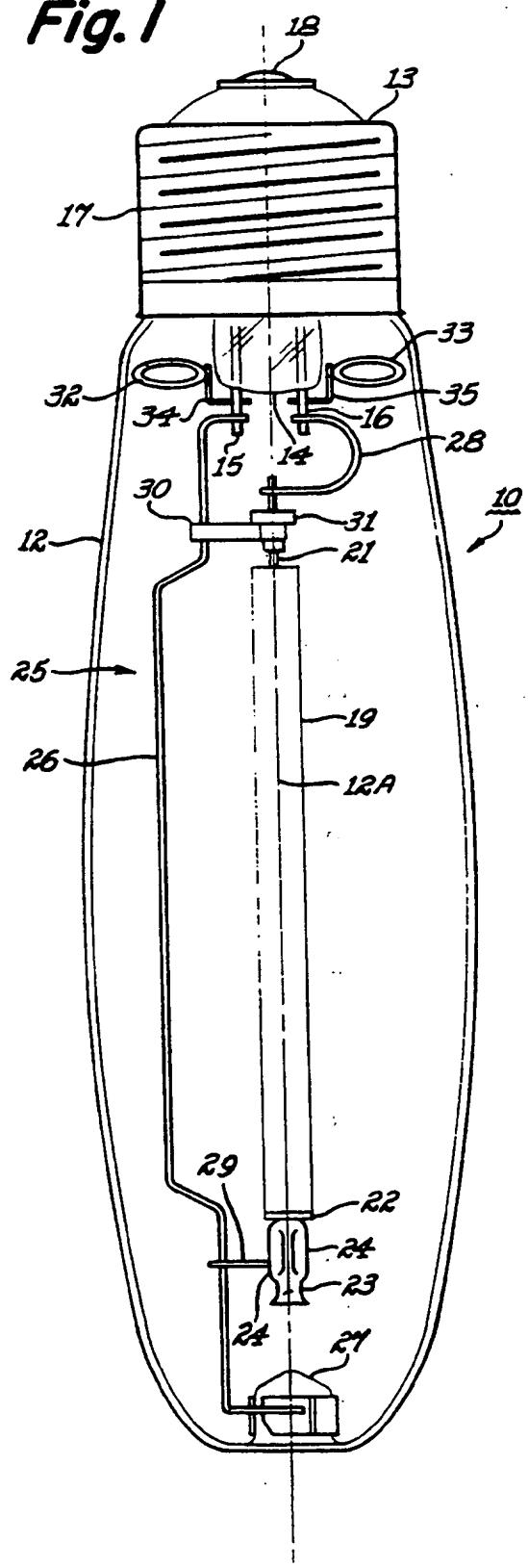
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*Fig. 1*



*Fig. 2*

Fig. 3

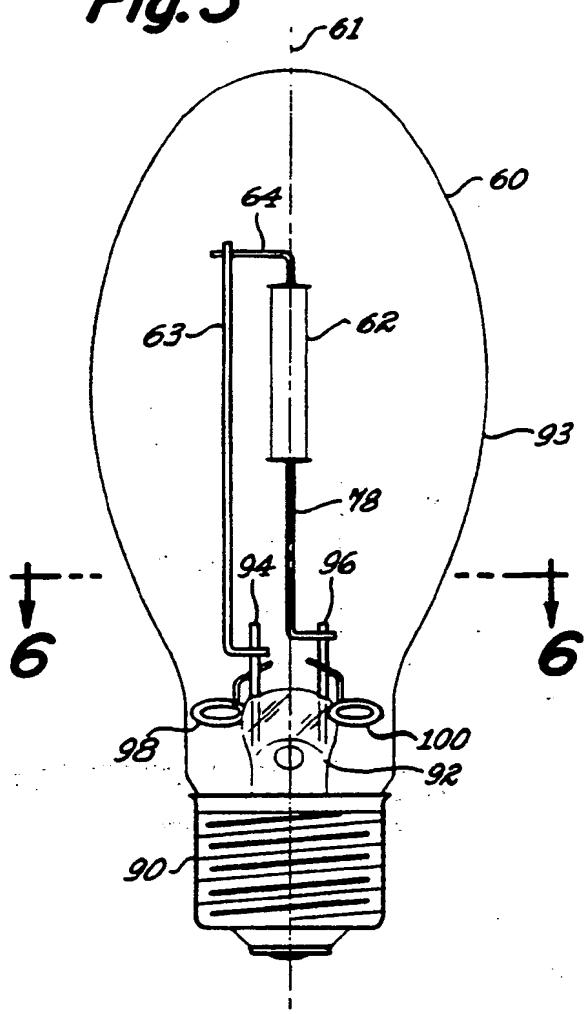


Fig. 4

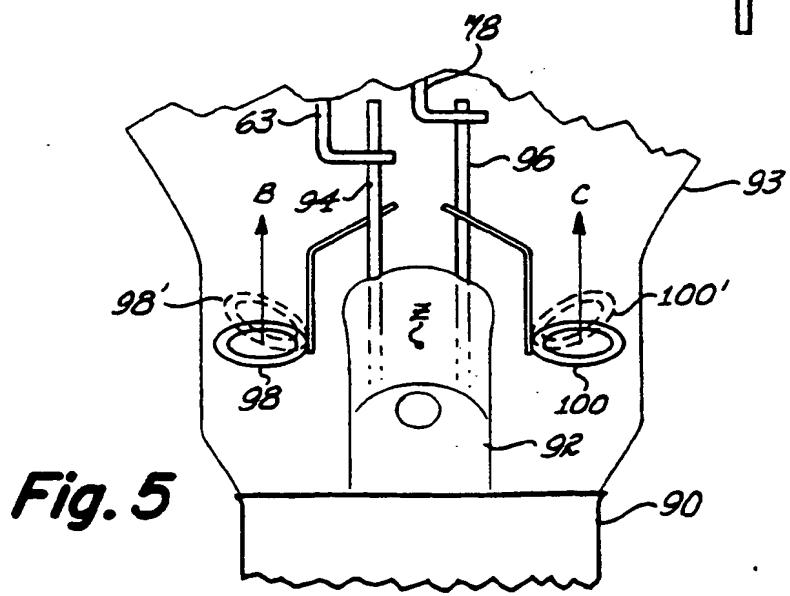
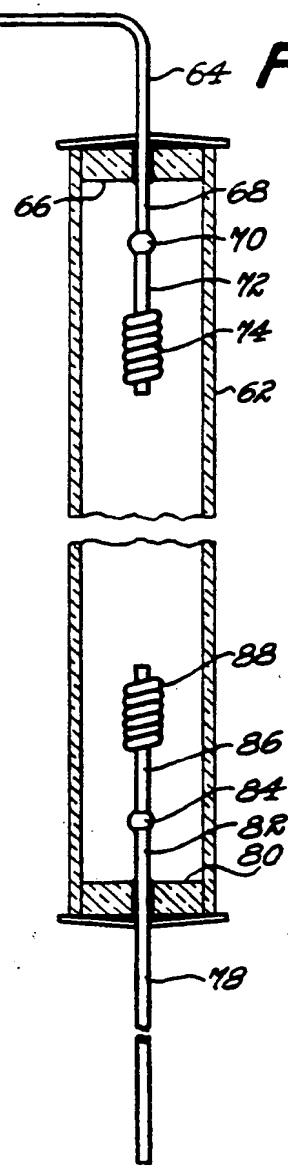


Fig. 5

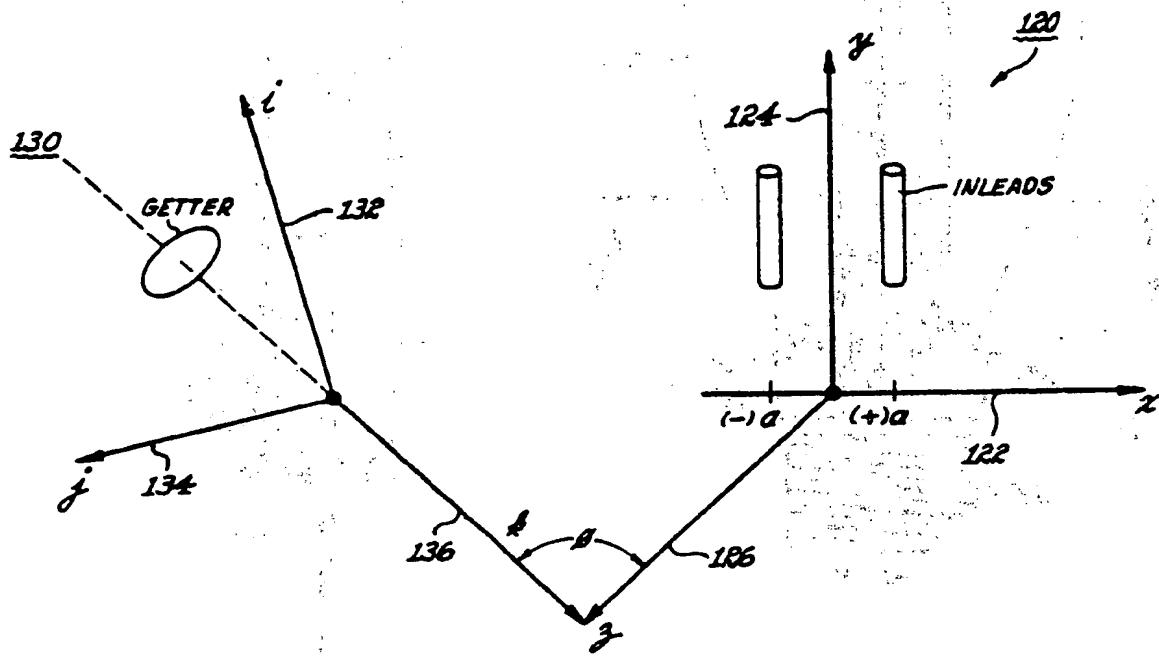


Fig. 6





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⑪ Publication number:

**0 385 243 A3**

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## EUROPEAN PATENT APPLICATION

⑬ Application number: 90103300.1

⑮ Int. Cl.<sup>5</sup>: H01J 61/82, H01J 61/073

⑯ Date of filing: 21.02.90

⑭ Priority: 03.03.89 US 318275

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⑮ Date of publication of application:  
05.09.90 Bulletin 90/36

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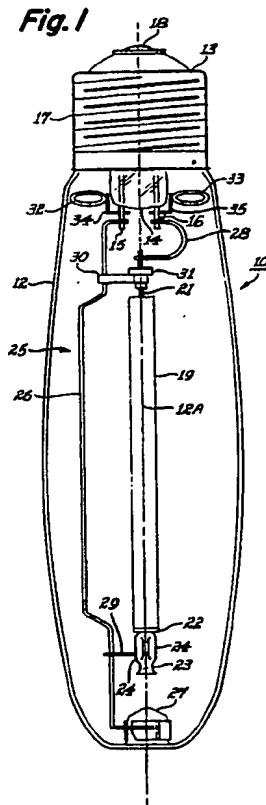
⑯ Designated Contracting States:  
DE FR GB NL

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⑯ Date of deferred publication of the search report:  
05.06.91 Bulletin  
91/23

### ⑯ Improved sodium vapor lamp for sonic pulse operation.

⑯ An improved high pressure sodium vapor lamp construction is provided for operation on sonic frequency pulses without excessive acoustic noise. The novel jacketed lamp construction employs non-magnetostrictive metal for the frame employed to suspend a ceramic arc tube within the outer jacket in combination with a particular orientation or placement for ring getter elements located within said outer envelope. Various lamp constructions embodying such improvement are disclosed to enable relatively noise free lamp operation.





European  
Patent Office

# EUROPEAN SEARCH REPORT

**Application Number**

EP 90 10 3300

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A,D	US-A-4 061 939 (STROK, Jr.) * Column 2, line 47 - column 4, line 59; figures 1,2 *	1,2,4, 8-10, 12-15, 19-21,23	H 01 J 61/82 H 01 J 61/073
A	US-A-4 380 714 (BOUMAN et al.) * Column 3, line 5 - column 4, line 16; figures 1,2 *	1,3,5,8, 10,12,19	
A	EP-A-0 100 091 (G.E.C.) * Page 5, line 1 - page 6, line 20; figures 1-3 *	1,4,5,8, 10,12,16, 20,21	
A	US-A-4 025 812 (Ch.I. McVEY) * Column 2, line 46 - column 3, line 26; figures 1,2 *	1,4,10, 12-15, 20-23	

**The present search report has been drawn up for all claims**

Place of search	Date of completion of search	Examiner
The Hague	13 March 91	JANDL F.
<b>CATEGORY OF CITED DOCUMENTS</b>		
X: particularly relevant if taken alone		E: earlier patent document, but published on, or after the filing date
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A: technological background		L: document cited for other reasons
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# EUROPEAN PATENT OFFICE

## Patent Abstracts of Japan

PUBLICATION NUMBER : 05325897  
PUBLICATION DATE : 10-12-93

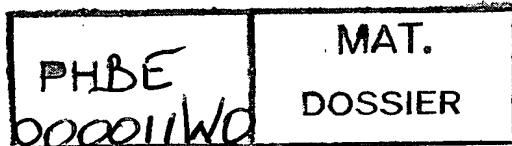
APPLICATION DATE : 26-05-92  
APPLICATION NUMBER : 04133282

APPLICANT : HITACHI LTD;

INVENTOR : KIMURA TAKESHI;

INT.CL. : H01J 61/35 H01J 61/34

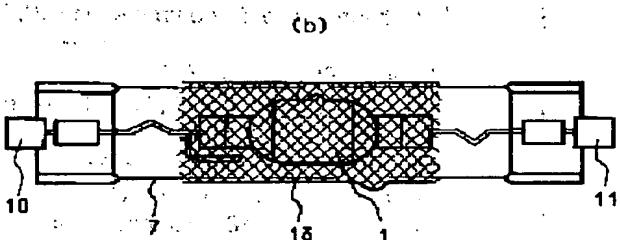
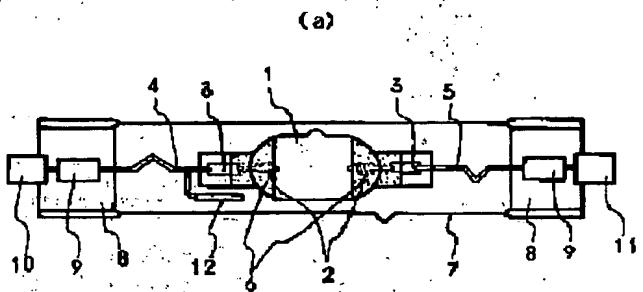
TITLE : METAL HALIDE LAMP;



ABSTRACT : PURPOSE: To improve the safety by preventing high temperature pieces of broken glass and a sealed substance such as mercury from scattering to the circumference by a light scattering substance, even through a luminous tube is broken, and furthermore, an outer tube is broken, when the lamp is lighted.

CONSTITUTION: In a metal halide lamp which has a luminous tube 1 having at least a pair of electrodes, and sealing a rare gas for starting, a metal halide, and mercury; and a translucent outer tube 7 containing the luminous tube 1; a light scattering substance 13 with a heat-resisting property is provided to cover at least along the full length of the luminous tube 1, to the surface of the outer tube 7.

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PHB/E 000011/WO	MAT. DOSSIER
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(19)日本国特許庁 (JP)

## (12) 公開特許公報 (A)

(11)特許出願公開番号

特開平5-325897

(43)公開日 平成5年(1993)12月10日

(51) Int.Cl. <sup>5</sup> H 01 J 61/35 61/34	識別記号 C 7135-5E	序内整理番号 C 7135-5E	F I	技術表示箇所
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審査請求 未請求 請求項の数5(全5頁)

(21)出願番号 特願平4-133282	(71)出願人 000005108 株式会社日立製作所 東京都千代田区神田駿河台四丁目6番地
(22)出願日 平成4年(1992)5月26日	(72)発明者 品田 真一 東京都青梅市藤橋888番地 株式会社日立 製作所青梅工場内
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	(74)代理人 弁理士 小川 勝男

最終頁に統ぐ

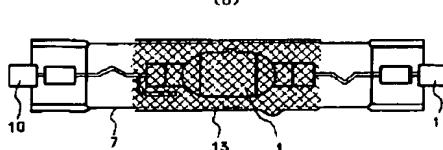
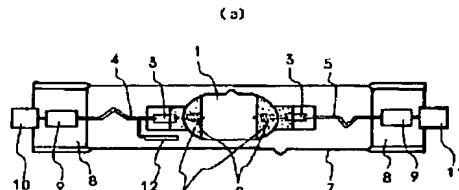
(54)【発明の名称】 メタルハライドランプ

(57)【要約】

【構成】少なくとも一対の電極を有し、始動用希ガスと金属ハロゲン化物と水銀とが封入された発光管1と、発光管1を内蔵した透光性の外管7とを備えたメタルハライドランプにおいて、外管7の表面に耐熱性の光散乱物質13を少なくとも発光管1の全長にわたって覆うよう設ける。

【効果】ランプ点灯中、発光管が破裂し、さらに外管まで破裂しても高温のガラス破片や水銀等の封入物は光散乱物質により止められて、周囲に飛散せず安全性が高い。

図1



1 …… 発光管	7 …… 外管
2 …… 電極	10, 11 …… 封入部
4, 5 …… リード線	12 …… グッタ
6 …… 保溫膜	13 …… 光散乱物質

1

## 【特許請求の範囲】

【請求項1】少なくとも一対の電極と、始動用希ガスと金属ハロゲン化物と水銀とが封入された発光管と、前記発光管を内蔵した透光性の外管とを含むメタルハライドランプにおいて、前記外管の表面に光散乱物質を設けたことを特徴とするメタルハライドランプ。

【請求項2】少なくとも一対の電極と、始動用希ガスと金属ハロゲン化物と水銀とが封入された発光管と、前記発光管を内蔵した透光性の外管とを含むメタルハライドランプにおいて、前記外管の表面に間隔をもうけて光散乱物質を設けたことを特徴とするメタルハライドランプ。

【請求項3】請求項1または2において、前記光散乱物質は、石英ガラスファイバであり、前記石英ガラスファイバをメッシュ状、スリーブ状、テープ状またはクロス状にして用いたメタルハライドランプ。

【請求項4】請求項1または2において、前記光散乱物質は、石英ガラスウールであり、前記石英ガラスウールを綿状、クロス状またはテープ状にして用いたメタルハライドランプ。

【請求項5】請求項1または2において、前記光散乱物質は、金属製のメッシュの表面にセラミックをコートしたものであり、前記メッシュを用いたメタルハライドランプ。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は、金属蒸気放電から放射される光を、照明用等の光源として用いるメタルハライドランプに関する。

## 【0002】

【従来の技術】コンパクトタイプのメタルハライドランプ(HQI等)は、例えば、特開昭64-19671号公報に示されているように、少なくとも一対の電極と始動用希ガスと水銀およびハロゲン化物の形にした発光金属を、高温・高圧に耐える透明石英ガラスからなる発光管に封入し、その発光管を透明石英ガラスの外管内に収容した構造になっている。

【0003】従来技術に示したメタルハライドランプ(以下、単にランプと略称する)は一般照明用の光源として広く使われているが、動作時に発光管の内圧が数気圧から10気圧程度になることや、点灯中に石英ガラス製の発光管と封入ハロゲン化物とが反応して、石英ガラスが結晶化、劣化し、場合によっては点灯中に発光管が破裂し、その破片が飛散して外管に衝突して外管まで破裂する恐れがあった。従来技術はこの点について考慮されておらず、万一、破裂したような場合には、高温のガラス破片が周囲に飛散する危険性があり、安全上大きな問題であった。

【0004】このため、ランプ破裂時の安全対策として、例えば、強化ガラスを使用した密閉型の照明器具

や、金網ガード付きの器具を用いているが、これらはメタルハライドランプ専用の器具であるため、非常に高価である等の問題があった。

【0005】また、最近ではメタルハライドランプの外管内部で、発光管の周囲にガラススリーブをかぶせ、破裂した発光管のガラス破片が飛散するのを防ぐものもあるが、破裂によるガラス破片の衝撃は強く、ガラススリーブが一個では外管を破壊することもあり完全な対策にはなり得ず、特開平-71054号公報に示すように、二重スリーブにする必要があり、構造が複雑でコスト高になる問題もあった。

## 【0006】

【発明が解決しようとする課題】本発明の目的は、簡単な構造で、ランプの発光管破裂時にガラス破片や封入物が周囲に飛散するのを防止した、高い安全性のランプを提供することにある。

## 【0007】

【課題を解決するための手段】上記目的を達成するため、本発明は、少なくとも一対の電極を有し、始動用希ガスと金属ハロゲン化物と水銀とが封入された発光管と、前記発光管を内蔵した透光性の外管とを備えたメタルハライドランプにおいて、前記外管の表面に耐熱性の光散乱物質を設ける。

## 【0008】

【作用】ランプ外管の表面に設けた耐熱性の光散乱物質は、少なくとも発光管の全長にわたって覆うように形成する。このため、ランプ点灯中に万一発光管が破裂し、その影響でさらに外管まで破裂しても、外管表面に設けた光散乱物質によって、高温のガラス破片や封入物が周囲に飛散するのを防ぐことができるので安全性が非常に高い。

【0009】耐熱性の光散乱物質は発光管から出射する光を拡散させるが、反射率が高いので光束の低下はほとんどなく、高効率で安全なメタルハライドランプを得ることができる。

## 【0010】

【実施例】本発明の実施例を図面に基づいて説明する。図1(a)はコンパクトタイプの両口金形メタルハライドランプの正面図、(b)は本発明によるコンパクトタイプの両口金形メタルハライドランプの一実施例を示す正面図。図2は本発明の他の実施例を示すメタルハライドランプの正面図。図3(a)は片口金形メタルハライドランプの正面図、図3(b)は本発明の他の実施例を示す片口金形メタルハライドランプの正面図である。

【0011】図1(a)において、石英ガラス製の発光管1の両端には、例えば、タンクステン製の一対の放電極2が設けられる。発光管1内にはよう化ナトリウム、よう化タリウムやよう化ディスプロシウム等の金属ハロゲン化物と、水銀および始動用ガスとしてのアルゴンが数kPa～数十kPa封入されている。電極2の基

部には、電極2を気密封入するためモリブデン箔3が埋設されており、さらにモリブデン箔3の端部には電力導入用のモリブデンリード線4、5が接続されている。発光管1の両電極近傍の外表面には酸化ジルコニウムを主成分とする保溫膜6が塗布されている。発光管1は石英ガラス製の外管7内に収容されており、外管7の両端には圧潰封止部8を有している。リード線4、5は圧潰封止部8で気密に封着されたモリブデン箔9を介して口金10、11にそれぞれ電気的に接続されている。12はゲッタであり、外管7内の不純ガスを除去する。外管7内は発光管の保溫や、ランプ特性が周囲の環境条件に左右されないように内部を、例えば、 $10^{-4}$ Pa程度の高真空中に排気してある。

【0012】メタルハライドランプの外管7の表面には、図1(b)に示したように石英ガラスファイバ製の光散乱物質13が発光管1の全長を覆うような長さで設けられている。

【0013】このような構造のランプで、石英ガラスファイバ13はメッシュ状あるいはテープ状、またはクロス状にして設けるとよい。石英ガラスファイバは単体でもよいが、通常は細いものを10～30本束にして纏つたものをメッシュに編んでパイプ状にしたもの用いるとよい。パイプ状にするとランプに装着するときにメッシュのパイプの中にランプを入れるだけの簡単な作業ができるので好ましい。また、メッシュ状にすることで強度が増し衝撃等に強くなり、ガラス片の飛散防止にはより効果的である。メッシュの線径は0.1～1.5mm、メッシュ寸法は5メッシュ以下、好ましくは10メッシュ以下が望ましい。なお、メッシュ寸法とは1インチ当たりのメッシュを構成する線の数を表す。

【0014】この構成のランプにおいて、ランプ点灯中に、万一、発光管1が破裂し、その飛散した破片でさらに外管7まで破裂しても、外管7の表面に設けた石英ガラスファイバ製のメッシュ13によって、高温のガラス破片や封入物が周囲に飛散するのを防ぐことができる。また、光散乱物質13は石英ガラスファイバ製であるため光の吸収が少なく、ランプからの発光は拡散として外部にほぼ全量が放出されるので、ランプ効率はほとんど低下することがない。

【0015】この実施例では光散乱物質13の長さは発光管1の全長とほぼ同じであるが、光散乱物質13の長さはこれに限ることはなく外管7の全体を覆っても良い。また、実施例では光散乱物質13のメッシュ線の方向は外管7の軸方向に対して斜めになるように形成してある。メッシュを斜め方向に形成すると、外管7の軸方向に対して伸縮性があるため、衝撃の吸収に対して有利である。しかし、メッシュの線方向はこれに限ることなく外管7の軸方向に対して直交していてもよい。

【0016】光散乱物質13はランプ点灯中600℃位まで温度上昇するので、この温度で変質、劣化しないよ

うな耐熱性が必要である。

【0017】光散乱物質13として実施例では石英ガラスファイバを用いたが、これに限ることなく、例えば、石英ガラスウールを綿状にして外管の表面に巻きつけ上から線を巻きつけて固定したり、あるいはテープ状にして巻きつけて用いてもよい。さらに、光散乱物質13には、耐熱金属、例えば、タンゲステン、モリブデン、白金、ニッケル、ステンレス等のメッシュを用いてもよい。この場合、金属メッシュによる光の吸収を防ぐため表面に反射率が高いアルミニウムシリカ等のセラミックをコートして用いる。光はメッシュの間から放出される。メッシュの寸法は5メッシュ以下、望ましくは10メッシュ以下がよく、また、金属メッシュの線径は、セラミックをコートした線径が通常の太さ、例えば、5メッシュでは約1.1mm、10メッシュでは約0.9mmになる位が望ましい。

【0018】光散乱物質13は外管7の表面に必ずしも密着して形成する必要はなく、図2に示したように外管7から離れていてもよい。本実施例で、光散乱物質13はその両端14を外管7の表面に溶着して固定し、ランプから光散乱物質が外れないようにしている。

【0019】図3は片口金形メタルハライドランプに本発明を適用した例であり、図3(a)において、石英ガラス製の発光管1には、例えば、タンゲステン製の一対の放電電極2が設けられ、電極2の基部には、電極2を気密封入するためモリブデン箔3が埋設されており、さらにモリブデン箔3の端部には電力導入用のモリブデンリード線4、5が接続されている。発光管1内には金属ハロゲン化物と、水銀および始動用ガスとしてのアルゴンが封入されている。発光管1は石英ガラス製の外管7内に収容されており、外管7の一端には圧潰封止部8を有している。リード線4、5は圧潰封止部8で気密に封着されたモリブデン箔9を介してリード線15、16にそれぞれ接続されている。外管7内は発光管の保溫や、ランプ特性が周囲の環境条件に左右されないように内部を、例えば、 $10^{-4}$ Pa程度の高真空中に排気してある。

【0020】片口金形メタルハライドランプの外管7の表面には、図3(b)に示したように本発明による、例えば、石英ガラスファイバ製の光散乱物質13が設けられている。石英ガラスファイバは、実施例と同じように、メッシュ状にしてあり、一端を閉じた袋状にしてある。発光管1の破裂に対する効果は実施例と全く同じである。

【0021】

【発明の効果】本発明によれば、メタルハライドランプの発光管を収容した外管バルブの表面に耐熱性の光散乱物質を設けることで、ランプ点灯中に発光管が破裂し、万一、外管まで破裂しても、高温のガラス破片や水銀等の封入物が周囲に飛散することができないので安全性が高い。

(4)

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## 【図面の簡単な説明】

【図1】本発明によるメタルハライドランプの一実施例を示す正面図。

【図2】本発明によるメタルハライドランプの第二の実施例を示す正面図。

【図3】本発明によるメタルハライドランプの第三の実

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## 施例を示す正面図。

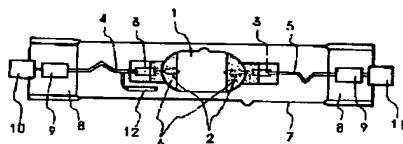
## 【符号の説明】

1…発光管、2…電極、4, 5…リード線、6…保温膜、7…外管、10, 11…口金、12…ゲッタ、13…光散乱物質。

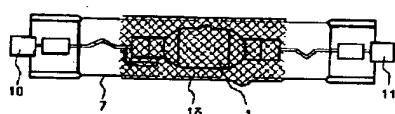
【図1】

図1

(a)



(b)



1…発光管  
2…電極  
4, 5…リード線  
6…保温膜

7…外管  
10, 11…口金  
12…ゲッタ  
13…光散乱物質

【図2】

図2

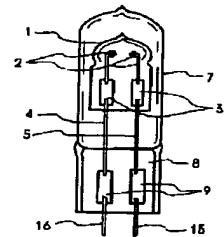


1…発光管  
7…外管  
10, 11…口金  
13…光散乱物質  
14…蓄圧部

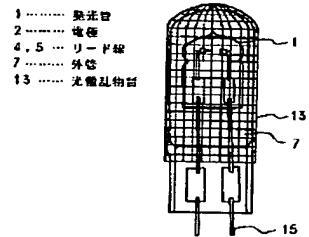
【図3】

図3

(a)



(b)



1…発光管  
2…電極  
4, 5…リード線  
7…外管  
13…光散乱物質

フロントページの続き

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